(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 130 076 B1**

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **21.08.91** (51) Int. Cl.5: **B21J 15/32**, B21J 15/10

(21) Application number: **84304287.0**

(22) Date of filing: **25.06.84**

The file contains technical information submitted after the application was filed and not included in this specification

(54) Riveting machines.

(30) Priority: **27.06.83 GB 8317389**

(43) Date of publication of application:
02.01.85 Bulletin 85/01

(45) Publication of the grant of the patent:
21.08.91 Bulletin 91/34

(84) Designated Contracting States:
AT BE CH DE FR IT LI LU NL SE

(56) References cited:
FR-A- 1 230 342
FR-A- 2 532 206
GB-A- 568 998
US-A- 2 754 860
US-A- 3 647 129
US-A- 3 805 583
US-A- 4 180 195

(73) Proprietor: **THE BIFURCATED AND TUBULAR RIVET COMPANY LIMITED**
Mandeville Road
Aylesbury Buckinghamshire HP21 8AB(GB)

(72) Inventor: **Bennett, Alan**
Croftdown Brent Road
Cossington Somerset(GB)
Inventor: **Ormston, Ronald**
17 Cotswold Green
Aylesbury Buckinghamshire(GB)
Inventor: **Morris, Paul E.**
55 High Beeches
Gerrards Cross Buckinghamshire SL9 7HY(GB)
Inventor: **Evans, Ronald**
96 Fowler Road
Aylesbury Buckinghamshire(GB)

(74) Representative: **Goodenough, Nigel et al**
A.A. Thornton & Co. Northumberland House
303-306 High Holborn
London WC1V 7LE(GB)

EP 0 130 076 B1

Description

This invention relates to a self-piercing riveting machine comprising: a riveting assembly including an anvil, a hydraulically powered rivet driver, and a rivet detainer, the riveting assembly being positionable in use to locate items to be riveted between the anvil and the rivet detainer and being operable to advance the rivet driver towards the anvil to drive a rivet from the rivet detainer to pierce at least one of the items and to be set by the anvil; a rivet supply mechanism for supplying rivets to the rivet detainer, the rivet supply mechanism including a bulk container for holding a bulk supply of rivets, delivery means for delivering rivets from the bulk container in a preferred orientation to a passage extending to the rivet detainer; and a compressed air supply for propelling each rivet along the passage to the rivet detainer and thereafter positively holding each rivet by air pressure in engagement with the rivet detainer until it is driven therefrom by the rivet driver.

Self-piercing riveting machines have been known for a number of years, and offer the substantial advantage that the items to be riveted need not be provided with preformed holes to receive a rivet. Such machines often utilize special hardened steel rivets which require a substantial force in order to drive the rivet in order to pierce the items to be riveted, and to set the rivet. For this reason, self-piercing riveting machines have tended to be large fixed installations, and this limits the use of such machines to applications where the items to be riveted can readily be presented to a fixed machine.

A riveting machine has been proposed in FR-1230342 in which a portable riveting assembly including an anvil, a rivet driver, and a rivet detainer is separated from the rivet supply mechanism, and is supplied with rivets via a flexible tube. The rivets are propelled longitudinally along the flexible tube into engagement with a detainer where they are held until they are driven from the detainer by the rivet driver. Because the rivets are driven along the rivet supply passage with the axis of each rivet parallel to the axis of the passage and the leading end of each rivet is smaller than the trailing end, there is the danger that the rivets will cant in the rivet supply passage, and jam the machine. Further, as the rivets enter the riveting head they must change direction. This change of direction occurs in the zone of a Y-shaped merging of the rivet supply passage and a passage for movement of the rivet driver. Accordingly, there is a substantial risk that a rivet will become disorientated at the point of change of direction with resultant jamming of the machine.

US-A-3647129 describes a stud feeding system for a welding tool in which studs are propelled to a welding tool along a supply passage.

In a machine according to the present invention having the characterising features of claim 1 the rivet supply passage, in the zone immediately adjacent the rivet detainer, extends perpendicular to the axis of movement of the rivet driver. The rivets themselves are constrained to move along the passage with the axis of each rivet perpendicular to the axis of the passage. The rivets accordingly enter the detainer with the axis of the rivet parallel to the axis of movement of the rivet detainer and no change of direction or orientation of the rivet is required as it enters the riveting assembly. This considerably simplifies construction of the riveting assembly and eliminates the causes of jamming referred to above. Further, in the machine according to the invention the rivet detainer comprises a pair of spring biased pocket members which in part define a pocket at the end of the rivet supply passage and which move apart to permit the rivet to be ejected from the pocket during setting, and the pocket members are part of a head assembly which, prior to rivet setting, is moved by the rivet driver into engagement with the items to be riveted to hold the items between the anvil and the head assembly during setting, the pocket members being at the extremity of the head assembly nearest to the anvil. The provision of a pair of spring biased pocket members at the extremity of the movable head assembly ensures that the rivet is fully controlled as to its position and orientation until immediately before it is forced into the first item to be riveted. This is in contrast with the arrangements of the prior art in which the rivet detaining mechanism is off-set to the rear of the riveting head with the result that there is the possibility of misalignment or loss of control of the rivet position after the rivet has been driven from the detainer but before the rivet engages the first item to be riveted.

In the preferred embodiment of the invention the riveting assembly forms a portable sub-unit which is connected to the rivet supply mechanism and hydraulic power source by flexible connectors, including a flexible tube which defines part of the rivet supply passage. In this manner the riveting assembly can be hand held to permit an operator to locate the assembly in a difficult position on, perhaps, a large fabrication or can be mounted on the arm of a robot machine to operate in a manner similar to a robot operated spot-welding machine.

Preferably the rivet passage forms a supply tube for supplying compressed air to hold the rivets against the rivet detainer. The rivet passage can, for example, be connected to a source of compressed air at all times when the riveting machine is in use. After each rivet is set a fresh rivet is injected into the passage and is propelled by the

compressed air to the rivet detainer where it is held by compressed air until required to be set.

The constant supply of compressed air maintaining each rivet against the rivet detainer until the rivet is driven forward by the rivet driver ensures that the riveting assembly can be used in any orientation, and this offers substantial advantage in utilization of the machine both on large fabrications and in robot controlled assembly operations.

In a particularly preferred embodiment of the invention the rivet passage is generally T-shaped in transverse cross-section, and rivets are propelled along it with the head of the rivet held within the head of the T, i.e. the longitudinal axis of each rivet is perpendicular to the longitudinal axis of the passage. In this way, the rivet can be brought to the correct position for setting in a particularly simple manner.

The above and further features and advantages of the invention will become clear from the following description of a preferred embodiment thereof, given by way of example only, reference being had to the accompanying drawings wherein:

Figure 1 is a side view and of a portable riveting assembly.

Figures 2 and 3 are respectively sections on the lines II-II and III-III of Figure 1; and

Figure 4 is a side view of a rivet supply mechanism and power unit.

Referring firstly to Figures 1 to 3 the portable riveting assembly 1 comprises a C-shaped frame 2 having a central portion 3 and arms 4A and 4B. A rivet setting anvil 5 is mounted on the frame 2 adjacent the extremity of one arm 4A, and a hydraulic ram 6 is mounted on the frame adjacent the extremity of the other arm 4B. The ram 6 has a piston rod 7 co-axially aligned with the anvil 5 for movement theretowards.

A head assembly 8 is slidably mounted on a block 9 which is in turn fixed to the central portion 3 of the frame 2. The head assembly 8 receives rivets along a supply passage via a flexible tube 10 as described in greater detail hereinafter, and upon movement of the piston rods 7 towards the anvil 5 advances into contact with the surface to receive the rivet, and thereafter guides the rivet as it is set by the riveting assembly.

The head assembly 8 includes a body 11 which is slidably mounted on the block 9, e.g. by way of a T-shaped head which engages in a complementary slot in the block. A plunger 12 is slidably mounted within the body and is normally connected to the piston rod 7 by way of a screw-threaded connection 13. The end 14 of the plunger includes an end face suitable for the rivet 15 to be set, e.g. if the rivet 15 has a flat head the end face of the plunger at the end 14 will be flat and will have an area substantially equal to that of the rivet head.

A compression spring 16 is pre-stressed between a shoulder 17 on the body 11 and a circlip 18 secured to the plunger. The spring 16 maintains the body 11 and plunger 12 in the relative positions shown in the drawing except during rivet setting, as described below.

A leaf spring 19 is secured to each side of the body 11 by way of respective screws 20 (omitted from Figure 2 in the interests of clarity). The free end of each leaf spring carries a pocket member 22. In their relaxed condition, the springs 19 hold the pocket members as illustrated in Figure 2 so that a rivet receiving pocket 23 is formed by the pocket members 22 and plunger end 14. In use, rivets are supplied to the pocket along a feed guide 21 and are maintained in position within the pocket by means of compressed air supplied to the guide 21 via the flexible tube 10. The shape of the pocket 23 is such that a constant supply of compressed air from the tube 10 will hold a rivet 15 in the position illustrated until actuation of the rivet setting sequence.

In order to rivet two members together, the riveting assembly 1 is positioned by hand or by computer control via a robot arm to position the items to be riveted in the throat 24 which is defined between the pocket members 22 and the anvil 5. At this time a rivet 15 will be in the position illustrated in Figure 2, and will be held in this position by compressed air as described above. To set the rivet hydraulic fluid under pressure is supplied to the ram 6 by way of an inlet fitting 25, causing the piston and piston rod 7 to move towards the anvil 5. As the piston rod 7 advances it carries with it the plunger 12, which in turn moves forward the body 11 and associated fittings through the action of spring 16. Movement continues until the items to be riveted are held between the anvil 5 and pocket members 22.

When the force supplied by the rams 6 is sufficient to overcome the pre-load of spring 16 and the effect of springs 19 and friction between the pocket members 22 and the item to be riveted, the plunger 12 will begin to move relative to the body 11 and will drive the rivet forward. The springs 19 yield to allow the pocket members 22 to move apart to accommodate forward movement of the rivet. The plunger 12 will then continue to move forward driving the rivet into the items to be riveted and setting the rivet in conventional manner. Forward movement of the plunger continues until the pressure within the hydraulic ram 6 reaches a predetermined set pressure, whereupon hydraulic pressure is released from the ram 6 and air return pressure is applied to the piston rod side of the piston in order to retract the piston rod and with it the head assembly.

The riveting assembly is then ready to receive a new rivet which is feed along the flexible tube 10 to the guide 21 to be held in the pocket 23 awaiting the next setting cycle.

It will be appreciated that the riveting assembly illustrated in the drawings is relatively small and can readily be manoeuvred by hand or on a robot arm. This renders the apparatus particularly suitable for use on large fabrication. It will also be noted that once a rivet 15 has been delivered to the pocket 23 it is positively held in position ready for setting by a compressed air flow, and accordingly the riveting assembly can be held at any angle to effect setting, and can be moved rapidly and in complex movement paths without displacing the rivet from the pocket 23.

To ensure that the rivet arrives at the guide 21 at the correct orientation to be received in the pocket 23 the flexible tube preferably has a T-shaped bore 26 as shown in Figure 3. Provided that the bore is suitably proportioned, a rivet inserted into the bore with its head in the cross-bar 26A of the T will move along the tube in that orientation, and will accordingly be correctly presented to the guide 21 for movement to the pocket 23.

Any suitable means may be provided to supply rivets to the flexible tube 10, hydraulic power to the inlet 25 and overall system control. Figure 4 shows schematically one suitable arrangement for providing for rivet feed and hydraulic power.

In the arrangement shown in Figure 4, a vibratory bowl feed device 30 of conventional design feeds rivets into a chute 31 for supply to an injector device 32 which, when triggered, inserts a single rivet into the flexible tube 10 for passage to the riveting assembly. Hydraulic power is provided by way of an air powered hydraulic intensifier 33. System control may be by way of pneumatic logic elements or electrical control or electronic logic control. In a typical embodiment using pneumatic logic control an entire riveting sequence may be put in hand merely by tripping the logic control whereupon air is applied to the intensifier 13 until the predetermined set pressure is reached, whereupon air pressure is released from the intensifier and a new rivet is injected into the flexible tube 10 by the injector 32.

The embodiment of the invention described above is particularly simple in that relatively few connections need extend between the riveting assembly and the rivet and power supply assembly, and such connections can all be relatively flexible. It will be appreciated, however, that other considerably more complex control arrangements can be used as circumstances require without departing from the scope of the invention as defined by the appended claims.

It will further be appreciated that different shapes and forms of rivet may be used in the machine by suitable choice of pocket members 22, anvil shape 5, and setting pressure.

Claims

1. A self-piercing riveting machine comprising: a riveting assembly (1) including an anvil (5), a hydraulically powered rivet driver (7,12), and a rivet detainer (19,22), the riveting assembly being positionable in use to locate items to be riveted between the anvil and the rivet detainer and being operable to advance the rivet driver towards the anvil to drive a rivet (15) from the rivet detainer to pierce at least one of the items and to be set by the anvil; a rivet supply mechanism for supplying rivets to the rivet detainer, the rivet supply mechanism including a bulk container (30) for holding a bulk supply of rivets, delivery means (31,32) for delivering rivets from the bulk container in a preferred orientation to a passage (26) extending to the rivet detainer; and a compressed air supply for propelling each rivet (15) along the passage (26) to the rivet detainer (19,22) and thereafter positively holding each rivet (15) by air pressure in engagement with the rivet detainer (19,22) until it is driven therefrom by the rivet driver (12) characterised in that the passage (26), immediately before it reaches the rivet detainers (19,22), extends substantially perpendicular to the axis of movement of the rivet driver (7,12); the rivets (15) are constrained to move along the passage (26) with the longitudinal axis of the rivets (15) substantially perpendicular to the longitudinal axis of the passage; the rivet detainer (19,22) comprises a pair of spring biased pocket members (22) which in part define a pocket (23) at the end of the rivet supply passage (26) and which move apart to permit the rivet (15) to be ejected from the pocket during setting; and the pocket members are part of a head assembly which, prior to rivet setting, is moved by the rivet driver (12) into engagement with the items to be riveted to hold the items between the anvil (5) and the head assembly (8) during setting, the pocket members (22) being at the extremity of the head assembly (8) nearest to the anvil (5).

2. A self-piercing riveting machine according to claim 1 characterised in that the riveting assembly (1) is movable as a sub-unit relative to the rivet supply mechanism (30-32) and hydraulic power source (33), and is connected to the rivet supply mechanism and hydraulic

power source by flexible connectors (10).

3. A self-piercing riveting machine according to claim 1 or claim 2 characterised in that air is continuously supplied to the riveting assembly (1) via the passage (26) to hold each rivet (15) in engagement with the rivet detainer (19,22).

4. A self-piercing riveting machine according to any preceding claim characterised in that the rivet supply passage (26) is generally T-shaped and rivets (15) are supplied along the passage (26) with the head of the rivet located in the head (26A) of the passage.

Revendications

1. Machine de rivetage auto-perceuse caractérisée en ce que le passage (26) s'étend sensiblement perpendiculairement à l'axe du mouvement du poussoir (7, 12) immédiatement avant d'atteindre le porte-rivet (19, 22) ; les rivets (15) sont contraints de circuler le long du passage (26) dans une position où l'axe longitudinal des rivets (15) sensiblement perpendiculaire à l'axe longitudinal du passage ; le porte-rivet (19, 22) comprend une paire de demi-poches (22) chargées par ressort qui, en partie, définissent une poche (23) à l'extrémité du passage (26) d'amenée des rivets, et qui s'écarte pour permettre au rivet (15) de s'éjecter de la poche pendant le matage ; et les demi-poches font partie d'un ensemble de tête qui, avant le matage du rivet, est poussé par la poussoir (12) en contact avec les objets à riveter pour maintenir les objets entre l'enclume (5) et l'ensemble de tête (8) pendant le mâtage, les demipoches (22) étant à l'extrémité de l'ensemble de tête (8) la plus proche de l'enclume (5).

2. Machine de rivetage auto-perceuse selon la revendication 1, caractérisée en ce que l'ensemble de rivetage (1) peut se déplacer comme une sous-unité par rapport au mécanisme (30-32) d'acheminement des rivets, et par rapport à la source d'énergie hydraulique (33), et est relié au mécanisme d'acheminement des rivets et à la source d'énergie hydraulique par des raccords flexibles (10).

3. Machine de rivetage auto-perceuse selon la revendication 1 ou la revendication 2, caractérisée en ce que de l'air est continuellement transmis à l'ensemble de rivetage (1) par l'intermédiaire du passage (26) pour maintenir chaque rivet (15) en contact avec le porte-rivet (19, 22).

4. Machine de rivetage auto-perceuse selon une quelconque des revendications précédentes, caractérisée en ce que le passage (26) d'amenée des rivets présente la forme générale d'un T et les rivets (15) sont acheminés le long du passage (26) avec la tête du rivet placée dans la tête (26A) du passage.

Patentansprüche

1. Eine selbstperforierende Nietmaschine, mit:

einer Nietbaugruppe (1), welche einen Amboß (5), eine hydraulisch betriebene Nietantriebseinrichtung (7, 12), und einen Niethalter (19, 22) enthält, wobei die Nietbaugruppe beim Gebrauch positioniert werden kann, um zu vernietende Gegenstände zwischen dem Amboß und dem Niethalter anzuordnen, und in der Lage ist, die Nietantriebseinrichtung in Richtung zu dem Amboß vorzuschieben, um einen Niet (15) aus dem Niethalter zu treiben, um wenigstens einen der Gegenstände zu perforieren und um durch den Amboß festgesetzt zu werden; einem Nietversorgungsmechanismus zum Zuführen von Nieten zu dem Niethalter, wobei der Nietversorgungsmechanismus einen Schüttgutcontainer (30) zum Aufbewahren einer Schüttgutversorgungsmenge von Nieten enthält, einer Zulieferungseinrichtung (31, 32) zum Zuliefern von Nieten von dem Schüttgutcontainer in einer bevorzugten Ausrichtung zu einem Durchgang (26), der sich zu dem Niethalter erstreckt; und einer Druckluftversorgung zum Treiben jedes Niets (15) entlang dem Durchgang (26) zu dem Niethalter (19, 22) und zum darauffolgenden festen Halten jedes Niets (15) durch Luftdruck im Eingriff mit dem Niethalter (19, 22), bis er durch die Nietantriebseinrichtung (12) aus diesem getrieben ist, **dadurch gekennzeichnet,** daß der Durchgang (26), unmittelbar bevor er den Niethalter (19, 22) erreicht, sich im wesentlichen senkrecht zu Achse der Bewegung der Nietantriebseinrichtung (7, 12) erstreckt; daß die Nieten (15) gezwungen werden, sich entlang des Weges (26) mit der Längsachse der Nieten (15) im wesentlichen senkrecht zu der Längsachse des Durchgangs zu bewegen; daß der Niethalter (19, 22) ein Paar von federbeaufschlagten Taschenteilen (22), welche teilweise eine Tasche (23) an dem Ende des Nietzuführungsweges (26) bilden, und welche sich voneinander wegbewegen, um dem Niet (15) zu ermöglichen, aus der Tasche während des Nietens ausgestoßen zu werden; und daß die Taschenteile ein Teil einer Kopfbaugruppe sind, welche vor dem Setzen des Niets durch die Niet-

abtriebseinrichtung (12) in den Eingriff mit den zu vernietenden Artikeln gebracht wird, um die Artikel zwischen dem Amboß (5) und der Kopfbaugruppe (8) während des Nietsetzens zu halten, wobei die Taschenteile (22) an dem äußersten Ende der Kopfbaugruppe (8) am nächsten zu dem Amboß (5) angeordnet sind.

2. Eine selbstperforierende Nietvorrichtung nach Anspruch 1, **dadurch gekennzeichnet,** daß die Nietbaugruppe (1) als eine Untereinheit relativ zu dem Nietversorgungsmechanismus (30 bis 32) und der hydraulischen Antriebsquelle (33) bewegbar ist, und mit dem Nietversorgungsmechanismus und der hydraulischen Antriebsquelle durch felxible Verbindungseinrichtungen (10) verbunden ist.

3. Eine selbstperforierende Nietvorrichtung nach Anspruch 1 oder 2, **dadurch gekennzeichnet,** daß kontinuierlich Luft zu der Nietbaugruppe (1) über den Durchgang (26) zugeführt wird, um jeden Niet (15) im Eingriff mit dem Niethalter (19, 22) zu halten.

4. Eine selbstperforierende Nietvorrichtung nach wenigstens einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet,** daß der Nietzuführungsdurchgang (26) im wesentlichen T-förmig ist und Nieten (15) entlang des Weges (16) mit dem Kopf der Nieten in dem Kopf (26a) des Durchgangs angeordnet zugeführt werden.

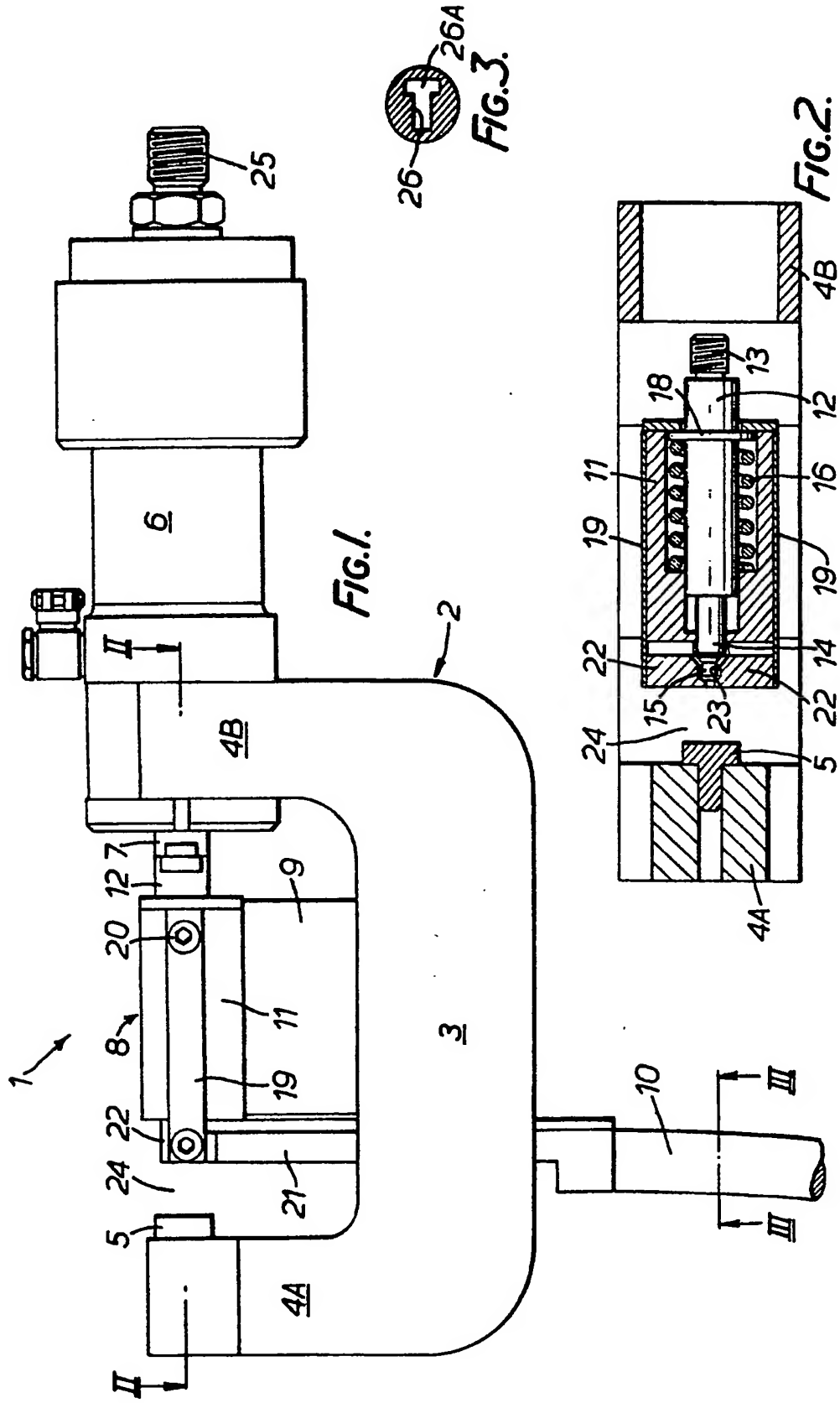

FIG.1.

FIG.2.

FIG.3.

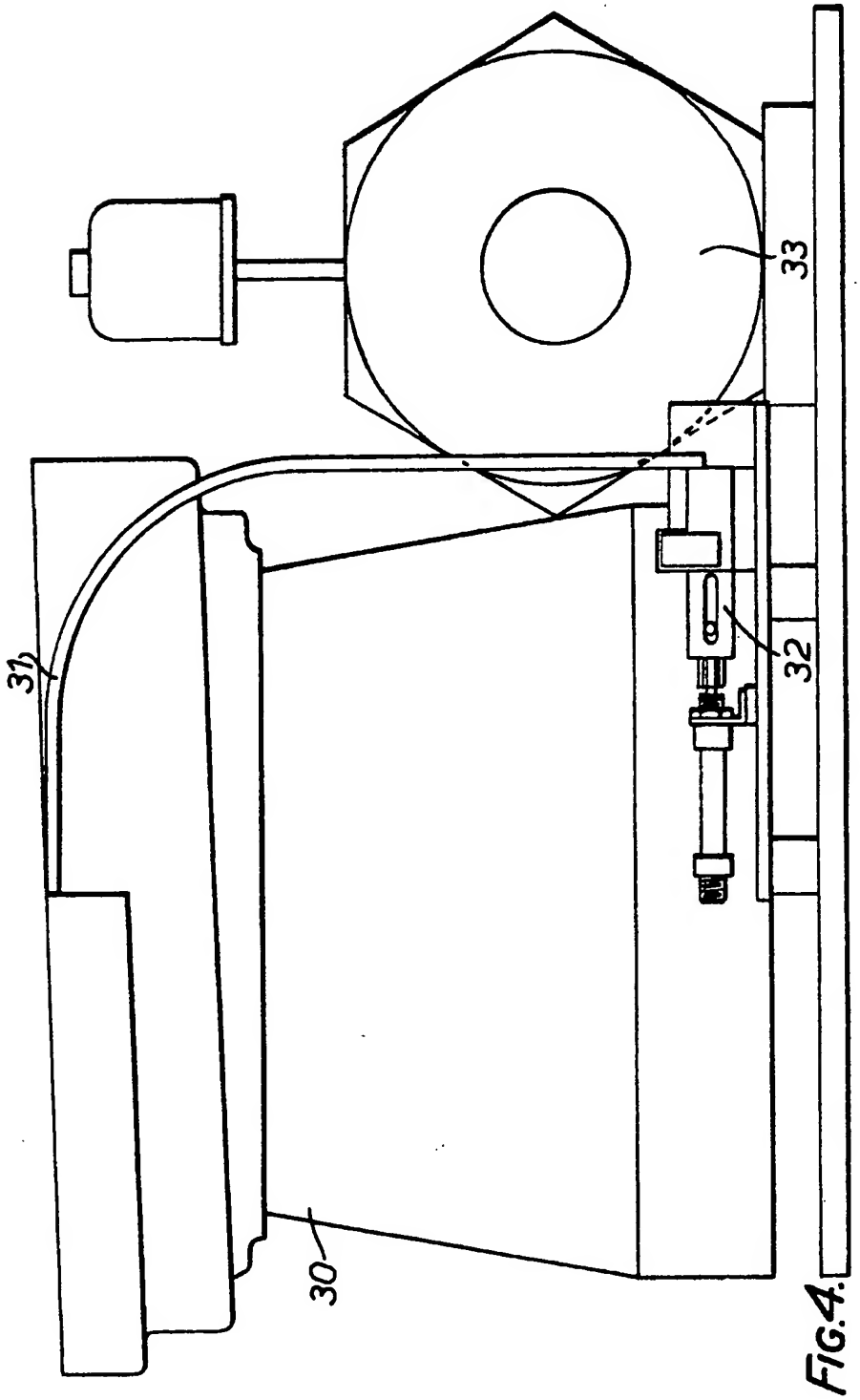

FIG.4.